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AVAILABILITY AND USE OF WEATHER DATA

CHARLES H. SMITH*

I. INTRODUCTION

THE BASIC nature of aviation dictates that weather conditions are an extremely important factor in aircraft operations. General aviation aircraft are, of course, normally subject to greater weather restrictions than large transport category aircraft. While equipment limitations account for some of the operating restrictions in general aviation, pilot training, skill, and proficiency are other major "operations limitations." More often than not in aviation accidents, it is the man rather than the machine which has exceeded its "operations limitation."

Undoubtedly, hail, icing, and turbulence can lead to catastrophic consequences if flight continues into such conditions unabated. In a vast majority of "weather related" aircraft accidents, however, these three major weather factors are not present. Rather, common IFR conditions such as rain, fog, low ceilings, and limited visibility are present almost without exception. Many "weather related" accidents are caused perhaps as much by pilot-in-command factors as weather factors. In many of these cases the probable cause determination indicates such pilot-in-command problems as: "continued VFR flight into adverse weather conditions"; "improper in-flight decisions or planning"; spatial disorientation; inadequate preflight preparation and/or planning; "attempted operation beyond experience level or ability"; and "exercised poor judgment."

These illustrations are intended to point out, as is generally recognized, that weather tends to precipitate aviation accidents

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rather than being their direct cause. Except for rare cases of in-flight break-up caused by turbulence, or jet engine flameout caused by hail, ice, or rain, or ice buildup on flying surfaces leading to an almost total deterioration of lift capability, weather generally does not directly cause aircraft accidents.

Inclement weather does tend to narrowly limit the margin of error available to a pilot. It also tends to inject an added dimension of stress into aircraft operations, while at the same time requiring a higher level of pilot skill to conduct the flight safely. The entire situation tends to create an atmosphere in which errors are more likely to occur at a time when an error can least be tolerated. At the present time, "weather related" accidents account for approximately twenty-five percent of all general aviation aircraft accidents. In a surprising number of these cases the weather forecast was substantially correct.

Because of the role which weather plays in aircraft operation, it is essential for the aviation practitioner to be able to acquire weather data in a timely and efficient manner for his initial analysis of a case and for later analysis by an expert should one be necessary. The purpose of this paper is to provide an overview of the national weather system and a survey of relevant aviation weather products. While many more weather products are available, only those most likely to be of interest in aviation operations have been considered. This paper will focus upon availability, content, and the significance of the various weather products considered.

II. AVAILABILITY OF WEATHER DATA

The agency primarily responsible for the coordination of aviation weather information is the National Weather Service (NWS), which operates primarily in cooperation with the Federal Aviation Administration (FAA), the National Aeronautics and Space Administration (NASA), and various military weather services.¹

¹ U.S. DEPT. OF COMMERCE & U.S. DEPT. OF TRANSP., AVIATION WEATHER SERVICES 1 (1977) [hereinafter cited as AVIATION WEATHER SERVICES 1977]; U.S. DEPT. OF COMMERCE & U.S. DEPT. OF TRANSP., AVIATION WEATHER 142 (1965) [hereinafter cited as AVIATION WEATHER 1965]. AVIATION WEATHER 1965 contains both general information on meteorology for pilots and details on the working and products of the national weather system. The current version has been split into two volumes: a more or less permanent volume of general mete-

Foreign weather services have a substantial input into the NWS as a result of the frequency of international flights coupled with the basic need for worldwide weather data.²

The present aviation weather collection and dissemination service did not come into being as a pre-planned operation, but rather was an outgrowth of what had been predominantly a public weather service for many years. As a consequence of demands for a more efficient and streamlined data collection and dissemination system, the aviation weather service program has been in a state of transition for the past several years.³ Many of the changes have been in the area of automatic data processing, storage and retrieval, as well as radar improvement, computerized analysis, and dissemination of radar information.

The cooperative effort between the NWS and the FAA dates back to the early days of the Weather Bureau and the Civil Aeronautics Administration (CAA). Many of the cooperative arrangements established between the CAA and the Weather Bureau remain in force today, accounting for the fact that almost all official hourly weather observations are made at airports.⁴ Even though the overall job of hourly observations is shared between the Weather Bureau and the FAA, many airlines and other private individuals and organizations participate. However, all official observations are taken by trained observers certified by the NWS.⁵

The changeable nature of weather data necessarily causes it to have a short, useful life. For that reason, frequent collection and rapid dissemination of basic weather data, as well as other weather products, is very important. The FAA Flight Service Station (FSS) is the principal distribution agency for aviation weather information. Virtually all of the weather data information available to a pilot is available through the FSS.⁶

orological information, U.S. DEPT. OF COMMERCE & U.S. DEPT. OF TRANSP., AVIATION WEATHER (1975); and AVIATION WEATHER SERVICES 1977, one of a planned series of periodic revisions of the information on the national weather system, which is steadily being improved and expanded.

² AVIATION WEATHER SERVICES 1977, *supra* note 1, at 1; AVIATION WEATHER 1965, *supra* note 1, at 142.

³ AVIATION WEATHER 1965, *supra* note 1, at 142.

⁴ *Id.*

⁵ *Id.*

⁶ AVIATION WEATHER SERVICES 1977, *supra* note 1, at 2.

The national weather system depends primarily on three sources of weather data: surface observations made at FAA Flight Service Stations (FSS) and other NWS observation points; radar observations, primarily of thunderstorms and other precipitation; and reports from pilots, who provide the only direct observations of turbulence, icing conditions, and cloud tops.⁷ In addition, observations of the upper atmosphere are made twice daily at selected stations, and satellite observations provide a broad picture of cloud coverage.⁸

Weather observations are relayed to the National Meteorological Center (NMC) outside Washington, D.C., where the data is processed by computer. NMC prepares forecasts and prognosis charts which are then distributed by teletype and facsimile circuits to various NWS offices and outlets. Some NMC products, e.g., winds aloft forecasts, are prepared specifically for aviation use; others, such as NMC prognosis charts, are the basis of area and terminal forecasts, subject to refinement and supplementation by area Weather Service Forecast Offices (WSFO's) and local Weather Service Offices (WSO's).⁹

The FSS is the most important outlet of aviation weather products for the pilot. The FSS has primary responsibility for providing both pre-flight and in-flight weather briefings. Many FSS's provide pre-recorded weather data for pilots, either by broadcasts on radio navigation aids or by telephone. The former are known as Transcribed Weather Broadcasts (TWEB's) and the latter as Pilot's Automatic Telephone Weather Answer Service (PATWAS).¹⁰ In addition, many areas of the country are now served by Flight Watch, an enroute weather advisory service which operates on a standard radio frequency nationwide to provide updated weather information and time-critical assistance to pilots in the air.¹¹

FAA Air Route Traffic Control Centers ("Centers") and terminal control facilities advise pilots of current weather conditions as necessary,¹² although the primary function of these facilities is

⁷ *Id.* at 1-2.

⁸ *Id.* at 2.

⁹ *Id.*

¹⁰ *Id.* at 2-3.

¹¹ *Id.* at 3.

¹² *Id.*

traffic control rather than weather briefing. In areas not served by FSS's, Weather Service Offices can provide pilot briefing services. The National Weather Service WSO's and WSFO's generally provide backup service for FAA weather service outlets.¹³

III. AVIATION WEATHER PRODUCTS

Many types of weather data products are available from the NWS, but only those of primary importance to aviation will be discussed here. Those products, available to the general aviation pilot through the FSS, include the following: surface weather observations; aviation weather reports; terminal forecasts; area forecasts; SIGMET's and Airmets; winds aloft forecasts; pilot reports (PIREP's); surface weather charts; and weather depiction charts. The nature, availability, and use of each of these products will be discussed in turn.

A. *Surface Weather Observations*¹⁴

Surface weather observations are made hourly, twenty-four hours a day, and recorded on a twenty-four hour log known as MF1-10. "Special" observations are made and recorded at any time the weather changes significantly between scheduled hourly observations. Both scheduled and special surface observations are transmitted to the National Weather Message Switching Center in Kansas City for distribution throughout the national weather system.

The Form MF1-10 logs of surface weather observations are generally retained by the observing station for ten days; copies of the MF1-10 forms are archived permanently at the National Climatic Center in Asheville, North Carolina. The raw observation record in the form of the MF1-10 should be distinguished from the teletype Aviation Weather Reports discussed below. While the basic data is generally the same, the format is different. A pilot would seldom if ever see the surface observation data in the form of the MF1-10; it is the teletype aviation weather report which is disseminated to FSS's and in turn to pilots.

Surface weather observations include most of the basic data

¹³ *Id.*

¹⁴ See generally *id.* at 17-24.

which bear on aviation operations and are usually made at an airport. Each hourly observation includes the following information: time of observation; sky cover and ceiling; visibility; obstructions to vision (rain, snow, smoke, fog, etc.); sea level barometric pressure; temperature; dew point; wind direction; wind speed; altimeter setting; and supplemental data.

Weather observation data is one of the single most important weather products for pilots, and is absolutely essential to virtually every phase of aircraft operation. However, surface weather observation data is by far more critical to the landing phase of flight than any other phase. To better understand the basic data, it is necessary to examine the component parts of an hourly observation report. Because some of the components are usually analyzed by the pilot in relevant groups, we will examine the components by such grouping.

Time of Observation

The pilot must be intently aware of the time lapse between the time an observation is made and the time it is to be used by the pilot. Weather can change rapidly and such changes can have a dramatic affect on the aircraft performance and the safety of the flight. For example, it is possible for a late afternoon thunderstorm to develop and dissipate very quickly in some areas of the world. The development of fog along sea coasts after sunset and dissipation shortly after sunrise is another example of the rapid change in weather conditions which can have a significant impact upon initiating or continuing the flight.

During atmospheric conditions with potential for rapid change, the pilot should be alert for and request data from "special" weather observations which are reported to reflect significant changes in weather conditions. The pilot can obtain this updated weather information while in flight by radio request to an FAA Flight Service Station. Approach control and tower facilities also have access to weather data and should immediately pass along any changes of condition in ceiling, visibility, wind, and altimeter settings. Changes in these conditions can have a significant effect on the pilot's decision to initiate or continue an instrument approach. Some courts have held air traffic controllers negligent for

failure to timely disseminate such weather data.¹⁵

Sky Cover and Visibility

Sky cover and visibility are the basic determinants for VFR or IFR flight. For example, flight within controlled air space requires a minimum visibility of three miles,¹⁶ and if VFR flight is to be conducted within a control zone,¹⁷ a minimum ceiling¹⁸ of 1,000 feet is required.¹⁹ If the ceiling and visibility values are less than permitted for VFR flight, then the flight must be conducted under a "special VFR" authorization or under instrument flight rules (IFR),²⁰ which requires among other things that the aircraft must meet certain minimum equipment requirements²¹ and the pilot must possess a valid and current instrument rating,²² file a flight plan and receive an appropriate Air Traffic Control (ATC) clearance.²³ While operating in VFR conditions, the pilot must maintain a certain specified distance between his aircraft and any clouds, and penetration of clouds or cloud layers is strictly forbidden.²⁴

By way of illustration, consider the hypothetical situation of Hewas Bold, holder of a private pilot's certificate but no instrument rating, who is proceeding cross country with his wife and friends in "VFR on top"²⁵ conditions. Upon arriving at his destination at approximately 10,000 feet above sea level, he finds a

¹⁵ See *Martin v. United States*, 448 F. Supp. 855 (E.D. Ark. 1977); *Ingham v. Eastern Airlines*, 373 F.2d 227 (2d Cir. 1967); *Gill v. United States*, 285 F. Supp. 253 (E.D. Tex. 1968), *aff'd in part, rev'd in part on other grounds*, 429 F.2d 1072 (5th Cir. 1970), *aff'd after remand*, 449 F.2d 765 (5th Cir. 1973).

¹⁶ See 14 C.F.R. § 91.105(a) (1978).

¹⁷ See 14 C.F.R. § 71.11 (1978) for the definition of a control zone. A control zone may include one or more airports and is generally a circular area with a radius of five miles and extensions as necessary to accommodate instrument approach and departure paths.

¹⁸ 14 C.F.R. § 1.1 (1978) defines ceiling as the "height above the earth's surface of the lowest layer of clouds or obscuring phenomena that is reported as 'broken,' 'overcast,' or 'obscuration,' and not classified as 'thin' or 'partial.'"

¹⁹ 14 C.F.R. § 91.105(c) (1978).

²⁰ 14 C.F.R. §§ 91.115-.129 (1978).

²¹ 14 C.F.R. § 91.33 (1978).

²² 14 C.F.R. § 61.57(e) (1978).

²³ 14 C.F.R. § 91.115 (1978).

²⁴ 14 C.F.R. § 91.105 (1978).

²⁵ "VFR on top" is defined as the operation of an aircraft over the top of a ceiling condition. 14 C.F.R. § 1.1 (1978).

solid overcast layer beginning at 9,000 feet above sea level. Running out of fuel and embarrassed to admit his predicament to ATC, he elects to descend through the overcast. Unknown to him, the cloud bases are reported to be 750 feet above ground level. His destination airport lies within a "control zone." While in the descent, he collides with a jumbo jet at an altitude of 2,500 feet above ground level.

In this situation, the pilot's initial entry into the control zone which was reporting less than VFR conditions was not in violation of any Federal Aviation Regulations (FAR's) since he was operating in VFR conditions on top. However, as soon as Mr. Bold entered the clouds, he was operating in IFR conditions and in violation of FAR's 91.105, 91.107, and 91.115.²⁶ Such conduct by Mr. Bold would surely be negligence *per se* since the purpose of such regulations is to forbid flight in IFR conditions unless conducted by a qualified pilot in accordance with an air traffic control clearance to provide aircraft separation. Such negligence could probably be established partially through the use of surface weather observations to show the existence of a 750 foot ceiling with a solid overcast layer of clouds forming such ceiling. Additionally, the tops of the clouds could be established by a radar determination, if the reporting station had such capability, or by PIREP's.

Consider the same basic set of facts except this time Mr. Bold loses control of the aircraft in the descent and spins to the ground, killing all occupants. Again, observed weather data and pilot reports could provide evidence of attempted VFR operation into IFR conditions resulting in spatial disorientation of the pilot and loss of aircraft control.

Assume that the main airport in the control zone is reporting a visibility of two miles and rain with a ceiling of 2,700 feet. This time, Mr. Bold arrives at the destination airport below the overcast and is attempting to maintain VFR flight at an altitude of 2,500 feet above ground level. While maneuvering near the airport for landing, Mr. Bold collides with a business jet as it breaks out of the 2,700 foot overcast while making an ATC authorized instrument approach to the airport.²⁷ Mr. Bold has not sought nor

²⁶ 14 C.F.R. §§ 91.105, 91.107, 91.115 (1978).

²⁷ If the approach control or air traffic control center controlling the flight was equipped with altitude readout capability on its radar scope, the business:

obtained a special VFR clearance.

Once again Mr. Bold was attempting VFR operation in IFR conditions. The reported visibility at the airport of intended landing could be introduced to establish IFR conditions within the control zone at the airport of intended landing and that Mr. Bold was thereby operating within the control zone in violation of the FAR's. Additionally, Mr. Bold was not maintaining the cloud separation required by FAR 91.105²⁸ since he was not at least 500 feet below the overcast. Of course, the business jet breaking out of the cloud layer at 2,700 feet would have little or no time to see and avoid Mr. Bold's aircraft which was in its flight path only 200 feet below the clouds. The observed weather data could be used to establish cloud heights, particularly if the accident occurred near the airport.

If Bold had requested and obtained a special VFR authorization, his operation within the control zone would have been proper as long as he simply remained "clear of the clouds" and the visibility was not less than one mile. In that case, his presence would be known to ATC and appropriate air traffic control procedures taken to prevent the jet from beginning its approach until Bold had safely landed.

Assume a smaller airport was located within the control zone approximately five miles from the primary airport, and that this minor airport did not have weather reporting capabilities. While descending for landing at the minor airport at an altitude of 2,300 feet, Mr. Bold collides with another aircraft en route to the major airport. The reported visibility at the major airport is two miles and rain and fog with a ceiling of 750 feet. Since Bold is proceeding to the minor airport, the prevailing flight visibility and ceiling rather than reported flight visibility and ceiling will apply. Therefore, while the reported visibility and ceiling at the primary airport would be some evidence of the conditions within the con-

jet's altitude reporting transponder may have reported the last altitude at which the collision occurred, and such altitude would appear on the radar screen as well as possibly appearing in the computerized radar readout data. If such information was reported by the transponder, the computerized radar data could probably be retrieved to establish the last reported altitude and consequently the probable altitude at which the collision occurred. In conjunction with the weather observations, such evidence could probably establish that Mr. Bold was not maintaining the required cloud separation.

²⁸ 14 C.F.R. § 91.105 (1978).

trol zone, such reported weather would not be conclusive. For example, it may be possible for the estate of the pilot to establish by ground witnesses or pilot reports that at the time and place when the accident occurred, the sky was clear and the visibility was greater than three miles. In that case, Bold would have been operating quite legally in VFR conditions at the time and place of the accident.

Reportedly visibility is also important when considering takeoff minimums for FAR Part 121 and Part 135 operations.²⁹ Standard minimum takeoff visibility for aircraft with two engines or less, when operating for hire, is one mile. Aircraft with more than two engines are permitted minimum take off visibility of one-half mile. Air traffic controllers are required to deny takeoff clearance to air carriers or other commercial aircraft carrying passengers or property for compensation or hire when the prevailing visibility is less than one-quarter mile.³⁰

Consider a situation where a Part 135 operator proceeds to take off in a light twin-engine aircraft with reported visibility of three-quarters of a mile and shortly after the aircraft becomes airborne, it crashes approximately one-half mile from the end of the runway. If it is an operation for hire, the takeoff minimums apply. While the pilot is responsible for determining visibility minimums, certainly the reported visibility of only three-quarters of a mile would be strong evidence that the pilot did not have the takeoff minimums. Only the "prevailing visibility" is reported, and it is defined as the greatest horizontal visibility in miles and fractions which is equalled or surpassed throughout at least one-half of the horizon circle. Therefore, the visibility could be three-quarters of one mile through seventy-five percent of the horizon circle and one and one-half miles in the other twenty-five percent of the horizon circle. If the pilot departed from a controlled field, the controllers' observation of visibility in the quadrant of the departure runway could very well establish that one mile visibility did not exist. However, if the pilot departed in the direction where the visibility was the greatest, for example one and one-half miles, then he did have take off minimums. If on the other hand the departure

²⁹ See 14 C.F.R. §§ 91.116, 121.1 *et seq.*, 135.1 *et seq.* (1978).

³⁰ See FAA, 1 AIRMAN'S INFORMATION MANUAL 58 (1977).

runway was equipped with a runway visual range (RVR)³¹ which is capable of measuring visibility in hundreds of feet, that data could be used to establish almost conclusively that the pilot either did or did not have takeoff minimums. The RVR of the runway is the first item expressed in the remarks section of an "hour sequence report."

Similarly, FAR 91.116(b)³² speaks to minimum visibility required for landing operations. As a part of each standard instrument approach procedure, a minimum landing visibility is prescribed. FAR 91.116 provides that no person may land an aircraft using a standard instrument approach unless the visibility is at or above landing minimums prescribed in the approach procedure. However, once the pilot has reached the minimum descent altitude³³ or decision height,³⁴ FAR 91.117(b)³⁵ provides that the pilot may continue the approach regardless of the reported visibility if the approach threshold of the runway or approach lights or other markings identifiable with the approach end of the runway are visible to the pilot.

Consider the situation where an aircraft is executing a published VOR instrument approach which provides for a visibility minimum of one mile and a minimum descent altitude (MDA) of 400 feet. The reported ceiling is 300 feet and visibility at the airport is one-half mile. The aircraft crashes three-quarters of a mile from the end of the runway. Although the pilot may execute the approach when not carrying passengers or property for compensation or hire under Parts 121 or 135, he must not descend below his minimum descent altitude until the runway is in sight. In this situation, the reported visibility and ceiling, while not conclusive would be persuasive evidence that the pilot descended below the MDA

³¹ Runway visual range (RVR) is an instrumentally derived value that represents a horizontal distance a pilot can see down the runway. The value is expressed in hundreds of feet. It is reported in the "Remarks" section of an "hourly sequence report" when the prevailing visibility is less than two miles and/or RVR is 6,000 feet or less. AVIATION WEATHER 1965, *supra* note 1, at 169.

³² 14 C.F.R. § 91.116(b) (1978).

³³ Minimum descent altitude is defined within the FAR's as the lowest altitude "to which descent is authorized on final approach or during circle-to-land maneuvering . . ." 14 C.F.R. § 1.1 (1978).

³⁴ The height at which, during a precision instrument approach, a decision must be made either to land or to execute a missed approach. *Id.*

³⁵ 14 C.F.R. § 91.117(b) (1978).

and missed approach point (MAP) without having the required visual contact with the runway.

Such an accident may also occur when the ceiling is, for example, 1,000 feet but the visibility is low, such as one-half mile. If the flight visibility from the cockpit is one-half mile, it can be a very difficult transition from flight instruments to visual contact with the runway. An unfortunate situation occurs when the pilot is able to see the approach lights and runway on the first approach but is either too high or fast to land at that point. He executes a missed approach and returns to the final approach fix to commence another approach while concentrating on being low enough to land the next time. It is usually on this second or later approach that the pilot may "bust minimums" by descending below the MDA to be in position to land when visual contact is made with the runway. At this point in the approach the pilot may have less than 400 feet separating his aircraft from the ground if there are trees or other obstacles in the approach path. It is in the final segment of the approach, with the pilot diverting his attention from the flight instruments to outside reference in hopes of spotting the runway or approach lights in time to land and attempting to fly at a critically low altitude by outside reference, that disaster occurs. For this reason, proof of an attempted approach in reported low visibility conditions along with expert pilot testimony discrediting such practices can tend to establish pilot negligence in commencing or continuing the approach. Proof of low prevailing visibility can also help to establish that the pilot was negligent for failing to execute a missed approach under conditions where he could not have safely maneuvered the aircraft to land from the MDA by the time he had visual contact with the runway. By establishing that reported visibility at the airport was less than one-half mile, it may be possible to establish negligence *per se* by the pilot in attempting the landing segment of the approach with less than the required minimum visibility. While it may not be negligence *per se* to attempt the approach in such conditions, it probably could be shown to be negligence *per se* to leave the minimum descent altitude with visibility less than the published minimums, without having the runway in sight or both. This is especially likely when there are no surviving witnesses.

Sea Level Pressure

Sea level pressure expressed in millibars is of some practical use to the pilot, particularly in pre-flight planning. It can be used in conjunction with previous observations to analyze the approach of a warm or cold frontal system. For example, a rapidly dropping pressure pattern could be a warning of a quickly approaching cold front. In that case, one might expect more severe thunderstorm activity because of the tremendous uplifting process associated with a rapidly moving cold front. The pilot could probably anticipate high winds and substantial turbulence to result from such conditions.

The pressure at the station will reach its lowest point upon frontal passage and be followed by a gradual increase in pressure. With increasing pressure, the pilot could probably expect clearing conditions and thunderstorm movement out of the area. Generally good flying conditions are associated with high pressure areas.

Therefore, even in the absence of a current forecast, a pilot should be aware that rapidly dropping station pressure may indicate the approach of significantly poor weather conditions such as thunderstorms and gusty, turbulent conditions. If the pilot is en route, this may indicate that a landing should be made to wait the frontal passage, and then proceed to the destination in more favorable flying conditions behind the cold front.

Dew Point and Temperature

Temperature and humidity have a tremendous affect on overall aircraft performance and particularly takeoff performance. In aviation weather reports, humidity is expressed in terms of "dew point," which is generally defined to be the temperature at which air becomes 100 percent saturated with moisture. When such saturation occurs, water vapor becomes visible in the air as clouds or fog or is visible on the ground as dew or frost. Obviously, sometimes the visible moisture falls to the earth as either rain, snow, or hail.

Because water vapor is in the air but not part of the air itself, it tends to reduce air density, which has a marked effect on aircraft performance. As air density decreases, thereby increasing "density altitude," the distance required for the takeoff run increases, rate of climb slows, and landing speed increases. All of

these factors have the potential for bringing about aircraft accidents, particularly if the pilot is unaware of the effects of humidity on aircraft performance.

Temperature also has the ability to decrease air density and thereby increase density altitude. As air is heated, it expands, thereby decreasing its density and weight. A cubic foot of warm air weighs less and is less dense than a cubic foot of cool air. A warm temperature, therefore, can bring about a decrease in aircraft performance similar to that of humid air.

Air density also decreases as altitude increases, thereby bringing about a corresponding decrease in aircraft performance. When increases in humidity, temperature, and altitude combine, aircraft performance can be substantially reduced. Even an experienced pilot may underestimate the amount of performance deterioration brought about by increases in these three factors when combined.

Generally the accidents which grow out of the combination of these three factors occur during take offs or climb outs from high altitude mountain airports. Consider, for example, the hypothetical case of Mr. Flatlander, a pilot with 500 to 1,000 hours of flying experience, the majority of such time in high performance single-engine aircraft operating primarily out of low altitude airports. He and four friends depart for a mountain vacation to Mile High City. Upon leaving Lowland Municipal Airport on a clear, cool (65°F) morning, he finds that his Belch Fire 6 aircraft is airborne in approximately 1,500 feet of runway and climbing at a tremendous rate. Arrival at Mile High City was uneventful except that Flatlander did notice that the touchdown speed and landing roll seemed much faster than normal. He notes the altitude at the airport was 7,500 feet and remembers that his flight instructor had always told him that landing speed (actually true airspeed) increases at high altitude airports without an increase in indicated air speed. However, on the day of departure, Flatlander loads the aircraft full of fuel, passengers, and baggage to its maximum gross weight limit. Remembering the fantastic performance of his Belch Fire 6 only a few days earlier, he does not check the aircraft's performance charts, even though it is a hot humid day, primarily because the runway is 4,500 feet in length and he feels that should be more than enough for today's operation. The temperature is 95°F, and the dew point is 80°F with the wind being

calm. During the takeoff run, the aircraft does not become airborne until approximately 4,000 feet of runway has been used and the rate of climb is insufficient to clear the seventy foot tall trees atop a thirty foot hill approximately 1,000 feet beyond the departure end of the runway.

This is one of the most common situations in which the extremely high "density altitude" gives rise to a significant decrease in aircraft performance. Decrease in air density equals an increase in density altitude. Although Flatlander was departing from an airport with a 7,500 foot elevation, the aircraft performed as though it were already at 11,000 feet. Had Flatlander simply checked the performance charts in the aircraft flight manual, he could have determined the minimum takeoff distance to clear a fifty foot obstacle with an outside air temperature of 95°F was 5,200 feet. Therefore, it should be clear to the pilot that the aircraft would not have the capability to clear a 100 foot obstacle within 5,500 feet of travel. However, if he had departed when the temperature was significantly cooler, for example, 65°F to 70°F, a successful departure could have been made. Both temperature and dew point information could be used in this instance to provide the basis for establishing the density altitude and flight performance data through expert testimony.

Temperature and dew point are also important to winter operation in the avoidance of icing conditions. Whenever visible moisture is present in the air in the form of clouds, rain, or sleet and when the temperature on the ground or aloft is at or below freezing, the potential for structural icing is present. At times, air dynamic cooling can lower the temperature of the air foil to below freezing even though the ambient air temperature is slightly above freezing. Icing is an extreme hazard to flying because it can reduce lift by destroying the aerodynamic curvature of the air foil. Ice also increases weight and drag as well as reducing thrust by decreasing the aerodynamic efficiency of the propeller. Unabated, these conditions generally result in the aircraft being unable to maintain altitude. This can be particularly dangerous in mountain terrain areas where the loss of even 1,000 to 2,000 feet of altitude could be disastrous.

An icing problem of a different type is "carburetor icing." Ice which forms in the throat of the carburetor has the potential for

causing complete loss of power if prompt corrective action is not taken by the pilot. Carburetor icing can occur when the temperature is as high as 77°F. However, it is most serious when the temperature and dew point approach 68°F or less. It is most likely to occur when moisture is visible in the air.

Carburetor icing can be a particularly deadly problem during a long gradual descent to landing with the engine idling. The rapid cooling of the engine from an idling descent along with the cooling produced by vaporization of fuel within the throat of the carburetor can bring about a rapid drop in the temperature of the air passing through the carburetor; perhaps a decrease of even as much as 60°F within a fraction of a second. Such rapid cooling causes any water vapor in the air to be forced out of the air and such moisture can then become deposited as frost or ice on the inside of the carburetor throat. If carburetor heat is not promptly applied, the pilot may experience complete power interruption. Because of the mechanics of the process of carburetor icing, temperature and dew point evidence can be very valuable in establishing conditions in which carburetor icing is most likely to occur, thereby tending to establish negligence on the part of the pilot in failing to timely apply carburetor heat during his descent and final approach to avoid the problem of carburetor icing.

Wind Direction and Speed

Wind direction and speed information is necessary for takeoff and landing operations. Generally aircraft take offs are made into the wind to reduce the ground roll speed and distance necessary for liftoff. An attempt to take off downwind can significantly increase the takeoff roll distance because of the greater ground roll speed necessary to develop sufficient air flow over the wings for takeoff lift.

For various reasons, pilots will from time to time attempt to take off downwind. If there is sufficient runway length, the take off can generally be made with very little difficulty. However, the temperature, humidity, altitude, and wind speed can combine to prevent the aircraft from becoming airborne within the length of runway available or not soon enough to avoid obstacles at the departure end of the runway. A pilot attempting a downwind take off during high temperature and humidity conditions is con-

ducting a very hazardous operation and in the event of an accident could very likely be found negligent for even attempting a take off under such conditions. If the wind is calm or light and variable, the pilot will normally have a choice of the takeoff direction. However, when the wind speed exceeds seven to ten knots, the prudent pilot would generally execute the take off into the wind to minimize the takeoff roll.

The same basic analysis applies to landing operations which in the absence of some other compelling reason should generally be made into the wind. In that way, touchdown speed and landing roll distance can be minimized. Evidence of wind direction and wind speed can call into question the conduct of the pilot in attempting a downwind landing which ultimately results in an accident.

Virtually all aircraft have cross wind take off and landing limitations. If a landing is attempted in a cross wind condition which exceeds the maximum cross wind limitation of the aircraft, the pilot will probably not be able to compensate for wind drift, and therefore will not be able to maintain runway alignment. If the landing is continued while the aircraft is drifting sideways, loss of control and disaster can result. Proof of wind direction and speed may tend to establish negligence on the part of the pilot if a landing was attempted when the reported wind direction and speed were in excess of the cross wind limitation of the aircraft as published in the owner's handbook or aircraft flight manual.

Consider also the case of a pilot landing a conventional gear (as distinguished from tricycle gear) aircraft in a significant cross wind. Upon landing, the aircraft veered to the right striking another aircraft. The wind was from the right at a significant rate of speed. The pilot alleges that the brake on the right side of the aircraft "hung" causing the aircraft to veer to the right. After the accident, the brake was inspected and appeared to function properly. At trial, wind direction and speed evidence could be introduced to establish that the aircraft "weathervaned" and veered to the right because of the significant wind from that direction. Such evidence would tend to show the pilot failed to maintain directional control and probably that the landing should not have been attempted at all under the circumstances.

Consideration of wind direction and speed is also important

when operating from airports used by large transport aircraft. Such aircraft, particularly jumbo jets, create an aerodynamic phenomenon referred to as "wing tip vortices" or "wake turbulence." Wing tip vortices spin from the wing tip of such aircraft and have been likened to horizontal tornados. These vortices have a tremendous rotational velocity which can roll most aircraft at such a rotational speed as to exceed the roll control capability of the aircraft. The vortices begin to form on take off at the point when the aircraft's wing first begins to produce lift. In a calm wind condition, these vortices move in a downward and outward direction from the path of the aircraft.

Wing tip vortices represent an extreme danger to all aircraft because they are invisible and "travel" with the wind if originally moving in a downwind direction. The vortex can be held in place by the wind if the original direction of movement of the vortex is into the wind. Such characteristics can be particularly hazardous at airports with parallel runways where the vortices from a departing jet may "travel" to the other parallel runway and create a takeoff hazard for departing light aircraft. In such a case, the pilot's first indication of the presence of the vortex will probably be shortly after he becomes airborne and is suddenly rolled and inverted. Without advance notice of this hazard, such an encounter normally results in disaster. The second situation involving wing tip vortices can occur many minutes after the jumbo jet has departed, perhaps even before the smaller aircraft has taxied out for take off. Because the wind speed is sufficient to "hold" the vortex on the runway for many minutes after the large jet has departed, the pilot may have no advance warning of its possible presence unless cautioned by the ATC about the departing jet. Again, a take off into such conditions by a pilot unaware of the hazard normally results in a fatal crash.

Wind direction and velocity play an important part in the pilot's takeoff strategy where he has been previously cautioned concerning the departure of a large transport aircraft. By anticipating the possible path of the wing tip vortices, the pilot may be able to avoid a disastrous result.

Gusty wind conditions can also have a significant affect on a pilot's planning for approach and landing speeds. Generally it is necessary to allow a slightly higher air speed on final approach

to avoid the possibility of a low altitude stall condition as a result of gusty winds. Additionally, a pilot may want to carry additional power all the way to touchdown in order to provide additional aircraft control and stability during the gusty condition. Therefore, wind direction and gusty conditions should be considered when investigating any approach to landing accident, particularly if an approach to landing stall occurs after the turn on final approach has been completed.

Altimeter Setting

The altimeter setting is the barometric pressure of the station in inches of mercury adjusted to sea level pressure. This barometric pressure is physically set by the pilot into a pressure sensitive altimeter, thus permitting the altimeter to indicate the correct altitude above sea level. The proper altimeter setting is necessary for all landing operations but is absolutely critical for instrument approach and landing operations. Failure to obtain the current altimeter setting for an airport under the influence of a low pressure system will cause the altimeter to read higher than the actual altitude of the aircraft. The dangers of the aircraft being operated at a lower altitude than indicated on the altimeter should be immediately apparent, particularly when operating under instrument conditions.

The altimeter setting is usually provided by tower air traffic controllers at the airport of intended landing. If an erroneous altimeter setting is given, the results can be disastrous. As an example, consider the situation where an aircraft is preparing to make a VOR approach and the controller provides the pilot with the proper altimeter setting. After a missed first approach, the controller provides clearance for another approach and at that time gives an erroneous altimeter setting of, for example, 29.92, one-tenth of an inch barometric pressure too high. The actual altimeter setting should be 29.82 and the resulting error is that the aircraft will be 100 feet lower than the altitude indicated by the altimeter. After the aircraft passes the final approach inbound, the tower again provides the correct altimeter setting of 29.82. Shortly thereafter, the approach terminates with the aircraft crashing into a wooded area of tall trees approximately fifty to seventy-five feet above ground level, one mile from the end of the runway.

A question which arises is whether the crew was simply "busting minimums" (flying below the prescribed altitude) or whether the erroneous altimeter setting which was corrected by the controller during the final stages of the approach caused sufficient cockpit confusion and distraction to bring about the aircraft's descent below MDA, resulting in the crash. It seems possible that a crew already at a 400 foot MDA might be sufficiently confused and distracted by the loss of 100 feet indicated altitude to lose another 130 feet of altitude while attempting to analyze the problem, and crash into the tree tops. Certainly the margin of error is small enough that such a distraction cannot be considered unrelated to such a crash.³⁶

B. *Aviation Weather Reports*³⁷

As pointed out previously, the hourly aviation weather report is basically the coded teletype transmission of surface weather observations from various stations. These reports are also referred to as "weather sequences," "hourly collections," and "hourly surface reports."³⁸ As with the surface observations, "special" reports are issued whenever the weather changes significantly between regularly scheduled reports.

The hourly aviation weather report contains the same basic data as the surface weather observation: sky cover and ceiling; visibility; obstructions to vision; sea level barometric pressure; temperature; dew point; wind direction; wind speed; and altimeter setting. There are two important distinctions between the two products: the aviation weather report is transmitted in a coded, single-line format which requires the use of a key or special training to interpret;³⁹ and the aviation weather report will often have "remarks" following the basic data, some of which may be vitally important to pilots, as illustrated below. Unlike the permanently archived MF1-10 logs of surface observations, aviation weather reports are retained for

³⁶ See *Martin v. United States*, 448 F. Supp. 855 (E.D. Ark. 1977).

³⁷ See generally AVIATION WEATHER SERVICES 1977, *supra* note 1, at 17-32.

³⁸ AVIATION WEATHER 1965, *supra* note 1, at 163.

³⁹ An explanation of the coded format is contained in U.S. DEPT. OF COMMERCE, KEY TO AVIATION WEATHER REPORTS (1976) [hereinafter cited as KEY TO AVIATION WEATHER REPORTS]. Key to Aviation Weather Reports can be obtained for a nominal price from the superintendent of documents, U.S. Government Printing Office, Washington, D.C. 20402.

only fourteen days by FSS's, and for ninety days by designated WSFO's.

In order to preserve Aviation Weather Reports, requests must be made within ninety days to the appropriate facility. The major disadvantage of the Aviation Weather Report is that the report for any one station is a one line sequence among several clusters of reports on one page. Usually, only one hourly observation is available on any one page, although several station reports may be listed on that one page. Thus, to obtain reports for any twenty-four hour period would require twenty-four copies. By contrast, the MF1-10 form usually contains all observations for a twenty-four hour period on one page unless many special observations are made, necessitating the use of a second page.

The Aviation Weather Report contains some basic information which is not contained in the MF1-10 form for service weather observation. This additional information is usually contained in the "remarks" section of the Aviation Weather Report. One of the most important bits of information contained therein is the NOTAM,⁴⁰ which is designated to alert airmen to potential hazards to air navigation. For example, consider the situation where Air Haven Airport closes one of its two runways for repair. The runway under repair has a substantial portion of the hard surface broken out and removed to allow for the repair. After the airport manager alerts the FAA to this hazardous condition, a NOTAM goes out over the teletype system for dissemination by flight service stations and other air traffic control facilities to all pilots planning to use the airport. Assume that one or two days after the NOTAM was originally issued and before it is published in the Airman's Information Manual, Mr. Businessman plans a trip to Air Haven Airport and calls the flight service station nearest his departure airport for an IFR weather briefing. The taped conversation reveals that Mr. Businessman was not advised that a runway was closed as a result of the construction. Businessman proceeds to Air Haven Airport and is cleared for an instrument approach to Air Haven Airport but is still not advised of the closed runway

⁴⁰ NOTAMS are notices to airmen of significant aviation operation data. NOTAMS may contain such data as the inoperation of a navigation aid, airport closed conditions, runway closed conditions, failure of airport lighting system, air show in progress, or any other limitation on aircraft operations or hazard to air safety.

condition. After breaking out of the clouds and while maneuvering for landing, he does not see the large yellow "X"s apparently intended to indicate the runway was closed because the "X"s were not on the runway itself but rather at the end of the runway in the grass. Neither does he notice that a portion of the black top runway was gone. Upon landing, Businessman still is not able to distinguish between the color of the black top runway and the dark colored mud area until immediately prior to running off the end of the black top area into the mud and doing substantial damage to his aircraft.

In this case, the actual presence and availability of the NOTAM within the system is critical. The actual NOTAM documents should be obtained along with certified copies of the teletyped aviation weather reports for the day in question. This evidence can be used to support an argument of negligence on the part of the Flight Service Station briefers as well as the air traffic controllers for failure to disseminate the NOTAM information to the pilot and warn him of the hazardous condition. It seems particularly distressing that an IFR flight could be handled for several hundred miles by air traffic controllers with access to such data and that the final center controller with jurisdiction over the sector within which this airport was located could clear an aircraft for an instrument approach and landing into said airport without ever mentioning that such a hazard existed.

Wind shift data is also contained in the "remarks" section of the Aviation Weather Report. It is generally valuable to the pilot to help determine frontal passage. This can be important to the pilot in anticipating clearing and improving weather conditions as well as anticipating the gusty wind conditions and turbulence usually associated with cold front activity. This information can be very valuable when investigating approach to landing accidents at or near the time of frontal passage.

The coded format of the Aviation Weather Reports will normally require expert testimony to decipher and explain. For this reason, the MF1-10 form may be more valuable inasmuch as it contains labeled columns indicating the nature of the recorded observations.

C. Terminal Forecasts⁴¹

The terminal forecast (FT) is a short-term forecast of weather conditions for a single airport. The FT is issued for a twenty-four hour period, but the forecast for the last six hours of each such period provides only an "outlook" describing the anticipated weather conditions in general terms. Like hourly Aviation Weather Reports, FT's are transmitted by teletype in a coded format which must be deciphered by a trained person or through the use of a "key."

Each FT generally contains the following forecast information: station identifier; date and valid time; sky cover and ceiling; visibility; weather and obstructions to vision; wind direction; wind speed; remarks (added to describe more completely the expected weather); expected changes (time of changes and expected conditions); and the six-hour categorical outlook. The body of an FT covers an area five miles in radius from the runway complex of the terminal; the remarks section covers a ten-mile radius. Terminal forecasts are prepared and issued three times daily by designated WSFO's. Each issuing WSFO retains the FT's for a period of five years.

Terminal forecasts have a variety of uses to the pilot and are probably the most important forecast product available. FT's are used primarily for flight planning purposes. While FT's may be helpful to a pilot to determine if the departure weather will be satisfactory at the departure airport twenty-four hours in advance of departure time, these forecasts are most valuable for destination and alternate airport planning. Terminal forecasts are also valuable in planning scheduled en route stops for fuel. Failure to consult these forecasts could put a pilot in the uncomfortable position of being unable to make a scheduled fuel stop because of adverse weather conditions, yet not having sufficient fuel on board to proceed to another airport. Actually, such a situation usually arises out of a combination of errors in judgment which is compounded by the poor pre-flight briefing and planning. However, skillful trial counsel could use such a forecast, if the actual weather was in conformity with the forecast, to show that the pilot should not have planned the fuel stop for that particular airport if the weather

⁴¹ See generally AVIATION WEATHER SERVICES 1977, *supra* note 1, at 37-44.

was marginal. If the weather was completely unsuitable for the scheduled stop, the pilot should have scheduled an earlier fuel stop or divided the stops in such a manner as to allow for sufficient fuel to fly to the next airport for fueling in the event the scheduled fuel stop could not be made.

The same basic considerations apply to analysis of destination weather and planning for an alternate airport in the event the flight cannot be completed as planned. FAR 91.5⁴² makes it incumbent upon the pilot to familiarize himself with all information available concerning the flight. Specifically, this information must include weather reports and forecasts, fuel requirements and alternatives available. It appears that failure to obtain a weather briefing of some description, whether by telephone or in person, may be negligence *per se*.

Actual weather data from hourly observations can be introduced to establish that the forecast was substantially correct and that the pilot would have known what conditions to expect if he had only obtained a weather briefing prior to commencing the flight. Where the weather is forecast to be unsatisfactory for VFR operations and the pilot does obtain a weather briefing, he should know that the flight could not be successfully completed in VFR conditions because of the inclement weather. Where the weather reports are substantially correct, little excuse can be made for the pilot who presses on into such conditions knowing in advance that they are expected to deteriorate rather than improve.

Terminal forecasts can also be used to show deteriorating weather conditions over a wide geographic area. In such a situation, it is necessary to obtain a collection of terminal forecasts for the given geographical area in order to establish specific forecast conditions of inclement weather. It has been held that a VFR pilot attempting to fly into such widespread deteriorating conditions was not exercising due care in pre-flight planning or in the conduct of the actual flight.⁴³

Forecast weather conditions dictate whether or not an alternate airport must be designated in an IFR flight plan.⁴⁴ Therefore, fore-

⁴² 14 C.F.R. § 91.5 (1978).

⁴³ See *Black v. United States*, 303 F. Supp. 1249 (N.D. Tex. 1969), *rev'd on other grounds*, 441 F.2d 741 (5th Cir. 1971).

⁴⁴ 14 C.F.R. § 91.83 (1978) provides in pertinent part as follows:

(a) Unless otherwise authorized by ATC, each person filing an

cast weather conditions are directly applicable in determining the minimum fuel requirements for an IFR flight.⁴⁵ If an alternate must be designated, sufficient fuel must be carried to fly to the airport of intended landing and then fly to the designated alternate with forty-five minutes of reserve fuel remaining at cruise speed. Additionally, current forecasts determine whether or not a particular airport may be designated as an alternate in an IFR flight plan.⁴⁶ If the ceiling and visibility are not forecast to be at or above prescribed alternate minimums at the estimated time of arrival at the alternate, then the airport cannot be designated as an alternate airport for an IFR flight.⁴⁷

IFR or VFR flight plan shall include in it the following information:

.....

(9) in the case of an IFR flight plan, an alternate airport, except as provided in Paragraph (b) of this section.

.....

(b) Paragraph (a)(9) of this section does not apply if Part 97 of this subchapter prescribes a standard instrument approach procedure for the first airport of intended landing and the weather minimums at the airport are forecast to be, from two hours before to two hours after the estimated time of arrival a ceiling of at least 1,000 feet above the lowest MEA, MOCA or altitude prescribed for the initial approach segment of the instrument approach procedure for the airport and visibility at least 3 miles or 2 miles more than the lowest authorized landing minimum visibility, whichever is greater.

⁴⁵ 14 C.F.R. § 91.23 (1978). When an alternate airport must be designated in the flight plan, sufficient fuel must be carried to permit flight to the first airport of intended landing and then flight to the designated alternate with sufficient fuel remaining for a flight at normal cruise for 45 minutes.

⁴⁶ 14 C.F.R. § 91.83(c) (1978).

⁴⁷ The alternate airport minimums prescribed by 14 C.F.R. § 91.83(c) (1978) generally provide that no person may include an alternate airport in an IFR flight plan unless the current weather forecast indicates that at the estimated time of arrival at the alternate airport, the ceiling and visibility at the airport will be at or above alternate minimums. If an instrument approach procedure is published for the intended alternate airport, then the alternate minimums published in that approach procedure shall govern. However, if none are so published then standard alternate minimums apply which are as follows: (1) for a precision approach procedure, ceiling 600 feet and visibility two statute miles; (2) for a non-precision approach procedure, ceiling 800 feet and visibility two statute miles. If no instrument approach procedure has been published for that airport, the ceiling and visibility minimums are those which will allow descent from the minimum enroute altitude (MEA) and approach and landing under basic VFR conditions.

An alternate airport must be designated whenever the weather conditions at the first airport of intended landing are forecast to have a ceiling less than 1,000 feet above certain minimum instrument arrival route altitudes or a visibility

Standard alternate minimums are in excess of standard instrument approach minimums for all airports. Even though an airport may have forecast weather conditions above instrument approach minimums at the estimated time of arrival, it cannot be used as an alternate airport if the forecast weather conditions are below alternate minimums. For example, Mr. Ace Pilot plans an instrument flight to Fort Worth, Texas, and the weather is such that an alternate must be designated. Mr. Pilot designates Dallas, Texas, as his alternate airport since it is so conveniently located. However, he does not determine the forecast weather conditions for Dallas at his estimated time of arrival. The alternate minimums for Dallas require a 600 foot ceiling and two miles visibility, while the minimums for an ILS approach to Dallas permit a 200 foot decision height and one-half mile visibility. A current terminal forecast at the time Mr. Pilot's IFR flight plan is filed indicates that the forecast weather at Mr. Pilot's estimated time of arrival in Dallas would be three-fourths mile visibility and a 400 foot ceiling. Upon approach to Fort Worth, the weather is sufficiently poor to force a missed approach and require Mr. Pilot to proceed to Dallas, his designated alternate. While enroute to Dallas, Mr. Pilot is advised that the current weather has just gone below approach minimums. With insufficient fuel on board to proceed to another airport where the weather might be more satisfactory, Mr. Pilot attempts an approach at Dallas and crashes approximately one-half mile from the airport. Because of his failure to check the forecast weather in Dallas to determine if it would be suitable as an alternate, Mr. Pilot is in violation of FAR 91.83(c)⁴⁸ for designating Dallas as an alternate when it was not forecast to be at or above alternate minimums even though the forecast weather conditions were above approach minimums. As a result of that initial error, Mr. Pilot did not have sufficient fuel on board to fly to a satisfactory alternate, a violation of FAR 91.23.⁴⁹ Additionally, Mr. Pilot was probably in violation of FAR 91.116⁵⁰ for attempting a landing when the weather was below minimums and when he probably did

less than three miles, from two hours before until two hours after the estimated time of arrival.

⁴⁸ 14 C.F.R. § 91.83(c) (1978).

⁴⁹ 14 C.F.R. § 91.23 (1978).

⁵⁰ 14 C.F.R. § 91.116 (1978).

not have visual contact with the runway environment. By introducing the terminal forecast in effect at the time the pilot departed on the IFR trip, it would probably be possible to establish the initial violation of FAR 91.83(c) which led to the subsequent problem of insufficient fuel on board to proceed to a more satisfactory alternate.

Amendments to forecasts are very important, not only for the updated forecast information but also as an indication of the unpredictability of impending weather. The fact that a forecast has been amended several times should call into question the reliability of a forecast. Certainly long term accuracy would be much more questionable than short term predictions. For that reason, a pilot should be on notice of the possibility of rapid change in weather conditions which would make it necessary for him to continue checking for updated forecasts as well as comparing current weather with current forecast weather data. If the actual weather is deviating from the forecast significantly, the pilot should allow for a greater margin of error in this forecast data when planning his flight.

D. *Area Forecasts*⁵¹

In contrast to the FT which covers only the immediate vicinity of a particular airport, the area forecast (FA) is a prediction of general weather conditions over an area the size of several states. An FA is valid for eighteen hours, with a categorical outlook covering an additional twelve-hour period. Amendments to FA's are issued as needed; however, only the portion of an FA affected by an amendment will be retransmitted between scheduled forecast times. FA's are transmitted by teletype in a narrative form, using common-sense abbreviations,⁵² so that they are relatively easy to interpret. FA's may be the only source of forecast weather for enroute airports if no FT's are available.

An area forecast contains the following main sections: heading, including issuing WSFO, date and time of issuance, and valid times; forecast area, generally in terms of states or portions of states and adjacent waters; height statement (all heights above sea level un-

⁵¹ See generally AVIATION WEATHER SERVICES 1977, *supra* note 1, at 44-46.

⁵² For a table of selected commonly used word contractions, see AVIATION WEATHER SERVICES 1977, *supra* note 1, at 117.

less noted, except that ceiling heights are always by definition above ground level); synopsis; significant clouds and weather; outlook; icing; and freezing levels. FA's are used primarily to determine forecast conditions enroute or for airports not covered by FT's. Area forecasts are prepared and issued twice daily by designated WSFO's. As with FT's, the FA's are retained for five years by the issuing WSFO.

Area forecasts are the only forecast products, except for SIGMET's and Airmets, which contain freezing level, icing conditions, and turbulence data. The area forecast is the only forecast product available which contains "cloud top" data. Information concerning icing is of prime importance to general aviation pilots, since most general aviation aircraft are not certified to operate in known icing conditions. If moderate or severe icing conditions exist or are forecast to begin within two hours, an Airmet or SIGMET will be issued to amend and supplement the area forecast. Flight into such conditions can have disastrous consequences, as rapid ice buildup leads to decay of lift, and ultimately to an inability to maintain continued flight.

The possibility of icing conditions should put a pilot on notice that further inquiry may be needed to determine whether or not such conditions have in fact developed. Area forecasts, as well as SIGMET's and Airmets can be used to build the foundation for establishing pilot negligence in proceeding into icing conditions in disregard of the warnings contained in such forecasts.

For example,⁵³ on a January day, Mr. Sky King, a multi-engine, non-instrument rated pilot flying a light twin-engine aircraft, receives a weather briefing for a flight to Chicago and is advised of forecast moderate icing conditions and IFR conditions at his destination airport. He is also advised that VFR weather is expected to exist by King's estimated time of arrival in Chicago. While enroute, King is advised that the weather at his destination is still IFR with a temperature of 31° F and dewpoint of 26°F with light snow. Although the terminal forecast continues to call for VFR conditions at King's time of arrival, an Airmet is issued warning of moderate icing in the clouds and precipitation over a three state

⁵³ These facts are adapted from *Somlo v. United States*, 416 F.2d 640 (7th Cir. 1969).

area including his destination, with freezing drizzle and ceilings generally below 1,000 feet and visibility below two miles. Although the aircraft is not deicer equipped, the pilot continues the trip, finally requesting and receiving IFR clearance, thereafter proceeding into the clouds. The aircraft begins icing very badly, ultimately is unable to maintain altitude and crashes approximately thirty minutes later.

After introduction of the forecast weather data, as well as the actual conditions in Chicago which were related to the pilot at various times during the trip, the court held⁵⁴ that it was the pilot's duty, having been warned of possible icing conditions, to inquire whether icing was still a factor. The pilot was negligent in bringing the aircraft into an area of known probable icing conditions in the middle of winter and failing to take immediate action to get the aircraft out of the air at the first indication of icing conditions. The court also points out that the pilot should have expected the possibility of visibility restrictions and moisture in the air leading to ice formation since the temperature and dewpoint spread was only 5°F.

The area forecast is also valuable to the pilot for the information which it contains concerning forecast turbulence. Like icing conditions, turbulence presents a major hazard to aircraft operations, and therefore pilots should be expected to use an extra measure of care in an area of forecast turbulence. Such a forecast should cause a pilot to make subsequent inquiries regarding the existence of pilot reports (PIREP's) concerning turbulent conditions. The benefit of the forecast data to the pilot is to permit him either to avoid the area of turbulence entirely or be prepared to take immediate action to slow the aircraft to maneuvering speed, the proper speed for penetration of turbulent conditions. Use of area forecast data in regard to turbulent weather conditions will be further discussed in connection with Airmets and SIGMET's.

Area forecasts are the only forecast product containing cloud top data. This information is generally useful to the VFR pilot who is considering a flight in VFR conditions above an enroute overcast to a destination airport reporting VFR conditions. The forecast can alert the pilot that the height of the clouds may be

⁵⁴ *Id.*

in excess of the maximum operating altitude of his aircraft. By using this data, the pilot can avoid becoming trapped on top of an overcast and being unable to climb above the clouds to maintain continued VFR flight. The problem of being trapped above an overcast while being unable to climb above the clouds can be a particularly difficult problem to the VFR pilot, especially if there is not sufficient fuel on board to return to an area of VFR conditions for a visual descent below the clouds. Such conditions can lead the pilot to the very foolish decision of attempting to let down through the clouds without the assistance of air traffic control to provide aircraft separation and directional guidance. In such conditions, a let down through the clouds can result in spatial disorientation and loss of aircraft control by the pilot with insufficient experience in operating the aircraft solely by reference to flight instruments.

As with other aviation weather data, an expert will be needed for in-court presentation, translation, and explanation of the narrative content of this forecast.

E. *SIGMET's and Airmets*⁵⁵

SIGMET's (WS's) and Airmets (WA's) are unscheduled forecasts which advise pilots of the actual or anticipated development of potentially hazardous weather conditions. For obvious reasons, they can also be very useful in pre-flight briefing and planning. SIGMET's and Airmets are transmitted by teletype in narrative form using abbreviations similar to those found in FA's, and additionally are included in appropriate pre-recorded broadcast (TWEB) and telephone (PATWAS) weather services. Each SIGMET or Airmet contains the following elements: station identifier; valid times; message identifier consisting of phonetic identifier (Alpha, Bravo, Charlie, etc.) and number; flight precaution statement describing the hazard and location; and further details, including additional descriptive details if needed or statement that the hazard is expected to continue beyond the valid time of the advisory.

SIGMET advisories warn of weather conditions potentially hazardous to *all* categories of aircraft, including large transport category aircraft. A SIGMET will be issued when any of the following

⁵⁵ See generally AVIATION WEATHER SERVICES 1977, *supra* note 1, at 47-48.

conditions is known to exist or is expected to develop within two hours: tornadoes; lines of thunderstorms (squall lines); embedded thunderstorms (cells hidden in cloud banks); hail three-quarter inches or greater in diameter; severe or extreme turbulence; wide-spread sandstorms or duststorms lowering visibilities to less than three miles.

Airmets advise of weather potentially hazardous to light single- or twin-engine aircraft but not necessarily significant to transport category aircraft. An Airmet is issued when any of the following conditions is known to exist or expected to develop within two hours: moderate icing; moderate turbulence; sustained winds of thirty knots or greater at or within 2000 feet of the surface; and the onset of extensive areas of visibility below three miles and/or ceilings of less than 1000 feet, including mountain ridges and passes. In addition, a Continuous Airmet will be issued to advise of moderate turbulence over mountainous terrain or continuing ceilings below 1000 feet and/or visibility below three miles. Unlike SIGMET's and Airmets, which are valid only for a stated period, Continuous Airmets remain in effect until cancelled.

SIGMET's and Airmets are issued as necessary by WSFO's. In addition to their status as independent advisories, they also serve to amend FA's for the affected area. Like FT's and FA's, SIGMET's and Airmet's are retained for five years by the issuing WSFO's.

As can be seen from the criteria for issuance, SIGMET's and Airmets contain critically important aviation operations hazards. While some of these hazards may be contained in area forecasts, certainly "in flight advisories" contain this data in its most un-obscured form. Because of the significance of the advisories, they are given priority dissemination, and are generally the first order of business in most competent weather briefings. These advisories are valuable to show poor pilot judgment by continued flight into known or forecasted severe hazards. All general aviation pilots should have received training in regard to Airmets and SIGMET's, and know or should know the significance of the hazards described therein.⁵⁶

⁵⁶ The hazards described to SIGMET's and Airmets are taught to pilots from primary flight training through more advanced ratings. See U.S. DEPT. OF TRANSP., PILOT'S HANDBOOK OF AERONAUTICAL KNOWLEDGE 53 (1971).

Since SIGMET's apply to all categories of aircraft, the pilot should expect that turbulence criteria should be with reference to large aircraft also. According to the turbulence reporting criterion tables,⁵⁷ severe turbulence generally causes large, abrupt changes in altitude and/or attitude. It usually causes large variations in indicated airspeed and may bring about momentary loss of aircraft control. Moderate turbulence, by contrast, can cause changes in altitude and/or attitude but the aircraft remains in positive control at all times. Since larger aircraft are usually less affected by turbulence than smaller aircraft, it may be inferred that turbulence expected to have a moderate effect on large aircraft could indeed have a severe effect on light aircraft. Proceeding one step further, severe turbulence for large aircraft may result in extreme turbulence for small aircraft causing a loss of aircraft control, structural damage and perhaps even inflight airframe disintegration.

For example, the pilot of a light twin-engine aircraft receives as part of his pilot weather briefing a SIGMET calling for moderate to severe turbulence along his route. Additionally, he is advised that within such area the cloud bases are expected to be 500 feet above ground level and cloud tops at 20,000 feet. While the aircraft is enroute, it is observed on the air traffic control radar that the aircraft has experienced several abrupt changes in altitude without a corresponding increase in the track speed of the aircraft. Shortly thereafter, the aircraft loses approximately 2,000 feet in one sweep of the radarscope and then disappears from the screen.

During the investigation, it is found that the aircraft broke up in flight with all of the wing and tail surfaces having broken away from the fuselage. Consideration is given to the possibility of autopilot malfunction or control surface flutter. However, during the investigation, it is also determined that several pilot reports of moderate turbulence for light twin-engine aircraft had been filed. This data, coupled with ground reports of strong gusty winds, could help establish inflight breakup caused by turbulent weather conditions and loss of aircraft control by the pilot. SIGMET data as well as actual weather conditions and pilot reports could tend to show pilot negligence in attempting operations into the fore-

⁵⁷ FAA, 1 AIRMAN'S INFORMATION MANUAL 95 (1977).

cast area of moderate turbulence as well as negligence in penetrating such an area at cruise speed rather than reducing to maneuvering speed for turbulence penetration.

Thunderstorms are an extreme hazard to aviation operations because of associated turbulence, hail, and lightning. Flight into areas where the thunderstorms are embedded in other cloud masses should not normally be attempted, particularly without airborne weather radar to assist in the detection and avoidance of thunderstorms. Any of these three factors has the potential for contributing to or bringing about an aircraft accident. The involvement of hail in bringing about an aircraft accident should be fairly obvious during the investigation from all of the signatures which hail would tend to leave on the aircraft.

F. Winds Aloft Forecast⁵⁸

Winds Aloft Forecasts (FD's) are prepared by the National Meteorological Center near Washington, D.C. and are issued for 100 locations in the forty-eight contiguous states. FD's are also prepared for a network of locations in Alaska.⁵⁹ FD's are prepared by computer and are issued in a coded format. Forecast temperatures aloft accompany the wind forecasts. FD's are retained for a period of five years by both the National Meteorological Center and certain designated Weather Service Forecast Offices. Not all WSFO's, however, retain FD's for their respective forecast area.

As with almost all of the weather products discussed above, in-court presentation of FD's requires decoding by a witness with some expertise in weather data interpretation, whether it be a pilot or a meteorologist. It should be remembered that FD's are a forecast product rather than actual winds aloft observations which are available from selected observation stations across the forty-eight states as well as Canada.⁶⁰ At times, it may be necessary to obtain the actual winds aloft observations for analysis. The forecast winds aloft may be of assistance in establishing the altitude at which a pilot seeking the most favorable winds would have been

⁵⁸ See generally AVIATION WEATHER SERVICES 1977, *supra* note 1, at 48-49. Stations for which FD's are prepared are shown *id.* at 6.

⁵⁹ *Id.* at 48.

⁶⁰ See AVIATION WEATHER 1965, *supra* note 1, at 144, 182. Rawinsonde observations yield information concerning the wind temperature, humidity and pressure to heights above 100,000 feet.

flying. This in turn may help to establish the altitude at which an engine failure occurred, or at which inflight breakup began to occur.

For example, a pilot operating a high performance single-engine aircraft with a four tank fuel system elects to fill only the main tanks and not the auxiliary tanks at his last fuel stop before the crash. At previous fuel stops all four tanks had been filled. While enroute to his destination airport, the pilot reports engine failure. The recorded transcript of the conversation indicates that the pilot was approximately 2,500 feet above ground level at that time. During the investigation, it is determined that the fuel selector level was positioned between a full main tank and an empty auxiliary tank, which could cause fuel starvation to the engine. It is also determined during the investigation that the mixture control was set to a lean mixture position which may have resulted in a mixture too lean to permit engine operation at the 2500 foot altitude.

The winds aloft data could be valuable as tending to show that the pilot was indeed at the 9,000 foot altitude as indicated in his flight plan. If he was at 9,000 feet, he should have had sufficient time to switch from a dry tank to a tank with fuel in it. In the event the fuel selector level was mispositioned initially, the pilot should have had ample time to diagnose the problem and take corrective action while descending from 9,000 feet. Additionally, if the pilot had properly leaned the mixture of the aircraft for operation at 9,000 feet it may be that the pilot would not be able to restart the engine once the aircraft had descended below, for example, 4,000 feet without repositioning the mixture control. In a case such as this, the winds aloft forecast is the only wind data available to the pilot and therefore his selection of cruising altitude would in all probability be based upon the most favorable wind condition as indicated by the forecast.

When winds aloft are forecast to be in excess of twenty-five knots, there is likelihood of possible turbulence.⁶¹ The likelihood of such turbulence may be an additional bit of evidence in establishing loss of aircraft control or airframe structural failure leading to inflight disintegration.

⁶¹ U.S. DEP'T OF COMMERCE AND U.S. DEP'T OF TRANSP., AVIATION WEATHER 86-88 (1975) [hereinafter cited as AVIATION WEATHER 1975]; OFFICE OF CHIEF OF NAVAL OPERATIONS, 1 METEOROLOGY FOR NAVAL AVIATORS 17-6, 17-7 (1973).

The forecast temperature aloft contained in the winds aloft forecast may be valuable in determining the likelihood of icing conditions, including carburetor icing. Consider for example a single engine aircraft operating in the clouds on an IFR flight plan at an altitude where the forecast temperature aloft is approximately 50°F. The aircraft is equipped with a fixed pitch propellor and the pilot notices a gradual drop in revolutions per minute (rpm) on the tachometer but takes no corrective action. Shortly thereafter, the engine quits and the pilot reports engine failure to the air traffic control center. The accident investigation reveals fuel on board the aircraft and no mechanical malfunction is found in the engine. However, the carburetor heat control is found in the "off" position. Based upon the temperature and visible moisture in the air at the cruising altitude, it may be possible to establish conditions likely to give rise to carburetor icing resulting in complete power interruption.

It will be, of course, impossible to conclusively establish carburetor icing as the cause of the accident since by the time the investigation takes place, the carburetor ice will have long since melted. However, by establishing the conditions likely to bring about carburetor icing and by ruling out mechanical failure, it may be possible to show the pilot did not take the appropriate corrective action of applying carburetor heat at the first indication of carburetor ice.

G. Pilot Reports⁶²

Reported observations of actual weather conditions by pilots in flight provide some of the most useful data in the aviation weather system. Pilot reports (PIREP's) can be the most timely and accurate information available; PIREP's are the only direct observations of cloud tops, icing, and turbulence. By filling some of the gaps between station reports, PIREP's help to provide a more accurate and complete picture of the weather than could be achieved through ground observations alone.

PIREP's are transmitted over the NWS teletype system, either in groups of PIREP's collated by states, or as remarks appended to hourly aviation weather reports. The PIREP format includes the following elements: identifier (the letters "UA" identify the

⁶² See generally AVIATION WEATHER SERVICES 1977, *supra* note 1, at 33-34.

message as a PIREP); location of observation; time of observation; phenomenon encountered (icing, turbulence, cloud tops, cloud bases, winds, bird migration, etc.); altitude; and, if the report is of turbulence or icing, type of aircraft reporting.

PIREP's are collected by FAA facilities, including Centers, terminal facilities, and FSS's. They are disseminated by teletype through area WSFO's; additionally, they may be used by FAA personnel for air traffic control or pre-flight briefing purposes. PIREP's are archived by designated WSFO's for five years. Like other teletype messages, PIREP's are also retained by the receiving FSS's for two weeks before being destroyed. Occasionally, it may be possible to trace a PIREP back to the FAA facility which took the original report from the pilot; this is usually the only way of establishing the identity of the aircraft which reported the condition, since its registration number is not a part of the PIREP.

Since pilot reports of existing weather conditions are the only eyewitness, enroute, airborne weather observations available, they can be very useful to establish the actual altitude of tops of an overcast as well as actual airborne flight visibility. Pilot reports may be the only way to accurately establish actual flight visibility on an instrument approach to an airport where an accident occurs shortly before or shortly after the pilot report is made. Pilot reports are the only actual observation of turbulence available for a given location at a given time. For that reason, in cases involving inflight aircraft disintegration from suspected turbulence, it is absolutely essential that a search be made for pilot reports made at or near the time and place of the accident.

H. *Surface Weather Maps*⁶³

A surface weather map provides a graphic display of weather data over the forty-eight contiguous states at a given time. Each map pictures the location of fronts, high and low pressure centers, barometric pressure contours ("isobars"), and the observations reported by surface stations. Surface observations are displayed through the use of a very compact, coded "station model" which, when decoded, provides the following information: sky cover and ceiling; visibility; temperature; dew point; wind direction; wind speed; precipitation; barometric pressure; and cloud data. The

⁶³ *Id.* at 53-56.

surface weather map is intended to provide a pilot with the "overall big picture" of the weather situation.

Surface weather maps are issued every three hours by the NMC outside Washington, D.C. The maps are distributed throughout the NWS by facsimile circuits. Observations shown on the map are approximately two hours old by the time the map reaches the field. For that reason, a pilot ordinarily would need to supplement the map with current hourly aviation weather reports. Surface weather maps are retained for ninety days at the NMC, then archived permanently at the National Climatic Center in Asheville, N.C.

The surface weather map is a valuable visual display of the location of fronts and associated surface weather. It can be particularly useful as a display of sky cover and wind direction and velocity. It is extremely valuable to show the location and movement of frontal systems into an area and the corresponding change of surface weather as a result of the approach and passage of the frontal system. In this situation, it is always useful to have several surface weather maps both preceding and following the time of the accident.

Consider, for example, the case of a non-instrument-rated pilot attempting to reach his destination airport prior to the arrival of a fast moving cold front. The activity associated with the front includes a solid line of thunderstorms with tops to 60,000 feet, heavy rain and possible hail, as well as moderate to severe turbulence. While enroute, the pilot discovers that the cold front has moved into the area of his destination airport and that a portion of the front now lays between his present position and the airport. Determined to press onward, the pilot encounters instrument conditions and turbulence resulting in spacial disorientation and a loss of aircraft control.

During the investigation it was found that the aircraft impacted the ground in a flat spin configuration. The surface weather map can be used to establish the movement of the front, the associated weather with each new position of the front, and the time of day corresponding with each new position of the front. In this way, it can be established that the front indeed did lie between the pilot and the airport at the time the accident occurred, and therefore that the pilot was negligent in attempting to continue the flight in IFR conditions, and particularly in attempting to penetrate the

fast moving cold front with its associated thunderstorm and turbulence activity, which resulted in loss of aircraft control.

I. *Weather Depiction Charts*⁶⁴

The weather depiction chart, in many ways a less cluttered version of the surface weather map, provides pilots with a quick, "plain view" of the overall weather situation. Like the surface map, the weather depiction chart shows the location of fronts, squall lines, and high and low pressure centers. In addition, areas of IFR⁶⁵ or marginal VFR⁶⁶ conditions are outlined with solid or scalloped lines, respectively. Surface observations are displayed through a simpler coded model which includes only the following information: total sky cover; heights of clouds or ceiling; significant weather or obstructions to vision; and visibility.

Like the surface weather maps, weather depiction charts are issued by the NMC and distributed over facsimile circuits. Observations depicted on the chart are approximately ninety minutes old when the chart reaches the field. Thus, although the chart is a valuable briefing tool for the pilot, it should be updated with current hourly sequence reports. Like surface maps, weather depiction charts are retained for ninety days at NMC and then archived permanently at the National Climatic Center.

A weather depiction chart presents vividly information directly affecting flight planning decisions. It is designed to alert pilots to the location of potentially critical weather conditions. Its readily understandable format—especially the outlining of areas of IFR and marginal VFR conditions—makes it a useful display of hazardous conditions at departure, enroute, and destination locations without the clutter of additional data contained in the surface weather map.

The weather depiction chart can be used in much the same way as the surface weather map in showing the movement of frontal systems and associated severe weather activity. The basic format of the weather depiction chart is perhaps the best for initially establishing significantly hazardous flying conditions in the area

⁶⁴ *Id.* at 57-59.

⁶⁵ Ceilings below 1,000 feet and/or visibilities less than three miles are shown as IFR on the weather depiction chart. *Id.* at 59.

⁶⁶ Ceilings 1,000 to 3,000 feet inclusive and/or visibilities three to five miles inclusive will be shown as Marginal VFR on the weather depiction chart. *Id.*

of the accident. By laying several of the charts side by side, it may be possible to show the movement of the frontal system and associated weather conditions in such a way as to lead the reasonably prudent pilot to the conclusion that the enroute and destination weather conditions may be unsuitable for the flight and therefore that the flight should be discontinued until after frontal passage. Generally, a fast moving cold front will tend to leave a clearing trend and very satisfactory flying conditions in its wake. It may be possible to show that if the pilot had simply delayed for a matter of one to three hours, the frontal system would have moved through the area leaving clear skies and good visibility.

IV. CERTIFICATION, AUTHENTICATION & ORDERING OF WEATHER DATA

Weather data may be obtained from NWS with either of two types of certification. A single document or small group of documents may be obtained with a "local certification," which is simply the signed statement of the meteorologist in charge of a NWS office that he has provided an "official true copy" of a record maintained by his office. All NWS offices can provide this service, and it represents the least expensive method of obtaining certified copies of weather records. "Local certification" has the disadvantage that it will not always satisfy the requirements for admission of the records into evidence.

Copies of weather records certified under the seal of the Department of Commerce may be obtained through several central offices of the NWS, most pertinently the Aviation Safety Evaluation Section in Silver Springs, Maryland.⁶⁷ This type of "authenticated certification" is not available through any local field office of the NWS. Certification under seal will satisfy the federal requirements for authentication of records, as well as most state "Official Records Acts," thus eliminating the need for authentication testimony.

The availability of certification under seal is only one of several advantages in ordering weather documents from a central source rather than through local field offices or centers. Because the various weather documents are retained only for specified times at

⁶⁷ The present mailing address is: Aviation Safety & Evaluation Section, National Weather Service Headquarters, Grammax Bldg., 8060 13th St., Room 1310, Silver Spring, MD 20910, ATTN: W116x3.

various locations, locating the facility which has possession of a particular record at any given time can be difficult. Retention times vary for different products and facilities, and it is not always easy to ascertain which facility has responsibility for retaining what documents.

One purpose of the Aviation Safety & Evaluation Section is to provide support services for aviation safety investigations and litigation. This section has the capability to retrieve any NWS weather product from any Center or Field Office,⁶⁸ and to copy and certify the retrieved documents under seal. The section makes a search charge based on actual man-hours expended, as well as standard charges for copying and certification. The section prefers that requests for documents be made in writing.

V. WEATHER DATA AS EVIDENCE

A. *Common Law Rule*

At common law, official written statements were recognized as an exception to the hearsay rule. However, at common law, only the original document could be used. Fortunately, the United States Supreme Court broke away from the English common law rule which refused to imply the authority of officials to certify copies of public documents in their custody.⁶⁹ Chief Justice Marshall announced the rule that the lawful custodian of a public record has by implication of his office, authority to certify copies. Since lawful custody implies authority to certify, in absence of statutory authority, the certificate is sufficient if it states the document bearing the certification is a copy of a document in the official's custody.

Even when the use of a certified copy is recognized, it still must be authenticated unless judicial notice is taken of the certifying officer's authority and signature.⁷⁰ Authentication generally requires proof of three elements: the authority of the official; that

⁶⁸ In addition to those weather products discussed above, the following are available: severe weather bulletins; winds aloft charts; radar reports (RAREPS); radar photographs; radar film (negative); convective outlooks and upper air charts; upper air soundings; winds aloft sequences; low level significant weather prognostic charts; high level significant weather prognostic charts; and satellite photographs.

⁶⁹ *Chruch v. Hubbart*, 6 U.S. (2 Cranch) 187 (1804).

⁷⁰ See 2 C. McCORMICK & R. RAY, *TEXAS EVIDENCE* § 1287 (2d Ed. 1956).

the person who signs the certificate is the holder of the specified office; and that the signature or seal on the certificate is his.⁷¹ These three elements must be proven by competent testimony. Authentication of the instrument can be accomplished at common law through the doctrine of authentication which provides that the existence of a seal or signature on a document is acceptable as sufficient evidence that the seal or signature is what it purports to be. This common law conception has been codified into some state statutes and the Federal Official Records Statutes.⁷²

B. *Official Records Statutes*

Most states have taken one of four different approaches to official records as evidence. Several states have adopted various forms of the Uniform Official Reports as Evidence Act.⁷³ Some states have devised their own statutory scheme for official records.⁷⁴ Others have adopted statutes similar to Rule 44 of the Federal Rules of Civil Procedure permitting authentication of records by certification under the seal of office of the Records Custodian.⁷⁵ Other states have enacted various codes of evidence similar to both the Uniform Rules of Evidence⁷⁶ or the Federal Rules of Evidence.⁷⁷

1. *Uniform Official Reports As Evidence Act*

The Uniform Act provides that written reports of state officials on matters within the scope of their duty as defined by statute shall be admitted as evidence of matters stated therein, subject to the bounds of relevancy.⁷⁸ As a prerequisite to admissibility, the party offering the report or document must deliver a copy of same to the adverse party a reasonable time before trial.⁷⁹ This require-

⁷¹ *Id.*

⁷² 28 U.S.C. § 1733 (1976).

⁷³ Idaho, North Dakota, Montana, and Texas have versions of the 1936 Uniform Official Reports as Evidence Act.

⁷⁴ See, e.g., N.Y. CIV. PRAC. RULES 4520, 4540 (McKinney 1963); CAL. EVID. CODE §§ 1280, 1452, 1531 (West 1963); IOWA CODE ANN. § 622.43 (West 1950).

⁷⁵ Maine, Montana, and New Mexico provide for the authentication of official records in a manner very similar to that provided for by Rule 44, FED. R. CIV. P.

⁷⁶ UNIFORM RULES OF EVIDENCE, 13 U.L.A. 197 (Master Ed. 1975).

⁷⁷ FED. R. EVID., 28 U.S.C. (1976).

⁷⁸ UNIFORM OFFICIAL REPORTS AS EVIDENCE ACT, § 1.

⁷⁹ *Id.*, § 2.

ment may be waived by the trial court if the adverse party has not been unfairly surprised by the failure to deliver a copy of the document.

For admissibility, normally it is not necessary that the public document is required to be kept by statute,⁸⁰ unless such requirement is provided by the Official Records statute itself.⁸¹ If the record or document is necessary and proper in the orderly conduct of business of the public office, then the document is admissible as an official record.⁸² The United States Supreme Court has held that official records are those records kept by persons in public office which the officials are required either by statute or by the nature of their office to compile. The report must consist of particular transactions occurring in the course of their public duties or under their personal observation.⁸³ The record must be a public record as distinguished from a personal record being kept by a public official.⁸⁴ Entries into the record need not be made by the official himself as long as the entries were made under his direction or control.⁸⁵ The keeping of the record must be a duty expressly imposed or implied by the office.⁸⁶ Weather reports and records are within the scope of this rule and are admissible as official records.⁸⁷

Since the general rule of admissibility assumes proper authentication, it stands to reason that close attention should be paid to the certification from the issuing agency. A record could be successfully challenged if, for instance, it bore only a statement by the "certifying officer" that it was a true copy of an official record,

⁸⁰ See 30 AM. JUR. 2d *Evidence* § 995 (1967).

⁸¹ See, e.g., N.Y. CIV. PRAC. R. 4520 (McKinney 1963), but see, *id.* R. 4540.

⁸² See 30 AM. JUR. 2d *Evidence* § 995 (1967); Annot., 34 A.L.R.2d 1249, 1251 (1954).

⁸³ *Evanston v. Gunn*, 99 U.S. 660 (1879).

⁸⁴ *Id.* at 666; *Green v. Martin*, 101 Me. 232, 63 A. 814 (1906).

⁸⁵ *Evanston v. Gunn*, 99 U.S. at 666-67; *White v. United States*, 164 U.S. 100, 103-04 (1896).

⁸⁶ *White v. United States*, 164 U.S. 100 (1896); *State v. Chase*, 330 A.2d 909, 911 (Me. 1975); *San Gabriel Land & Water Co. v. Witmar Bros.*, 96 Cal. 623, 29 P. 500, 502, *aff'd on reh.*, 31 P. 588 (1892).

⁸⁷ *Southwest Bitulithic Co. v. Dickey*, 28 S.W.2d 264, 267 (Tex. Civ. App.—Eastland 1930, no writ); *Mears v. New York, N.H. & H.R.R.*, 75 Conn. 170, 52 A. 610 (1902); *Eaves v. Ottumwa*, 240 Iowa 956, 38 N.W.2d 761, 767 (1949); *Wheeler v. Fidelity & Cas. Co. of N.Y.*, 298 Mo. 619, 251 S.W. 924, 931 (1923); *Shamrock Towing Co. v. Cornell Steamboat Co.*, 49 F.2d 785 (S.D.N.Y. 1930).

yet lacked the official seal of a public office.⁸⁸ Therefore, the record itself or a duly authenticated copy must be introduced, and in its absence, testimony even from its custodian as to what the record reflects would be hearsay although the custodian may authenticate the record.⁸⁹ Of course, weather records are not admissible to show collateral facts noted therein, nor for conclusions and opinions based upon newspaper clippings, reports of untrained observers or other hearsay statements.⁹⁰

2. Rule 44 Statutes

Some states have enacted statutes patterned after Rule 44 of the Federal Rules of Civil Procedure providing for authentication by official seal or publication.⁹¹ For example, the Montana statute is substantially the same as Rule 44, particularly in regard to domestic governmental records.⁹² Although these statutes provide for authentication by seal, admissibility depends upon the Official Records statute or codified rules of evidence in such states.⁹³ While New Mexico has adopted rules of procedure for state courts similar to the Federal Rules of Civil Procedure, the domestic records section of Rule 44 differ greatly from the federal version of the rule. New Mexico's Rule 44 provides that copies of documents authenticated under seal shall be admitted into evidence equally with the originals. The statute seems to provide for not only admissibility of official records but copies thereof as well as permitting the records' authenticity to be established by official seal. New Mexico has also enacted an evidence code, similar to the Federal Rules of Evidence, which generally provides that official records, reports, and data compilations of public offices or agencies are not excluded by the hearsay rule.

⁸⁸ *Celanese Corp. of America v. Vandalia Warehouse Corp.*, 424 F.2d 1176 (7th Cir. 1970); see also *Taylor v. State*, 158 S.W.2d 881 (Tex. Civ. App.—Waco 1942, writ ref'd w.o.m.).

⁸⁹ *Hillin v. Hagler*, 286 S.W.2d 661, 662 (Tex. Civ. App.—Ft. Worth 1956, no writ).

⁹⁰ 30 AM. JUR. 2d *Evidence* § 1001 (1967).

⁹¹ Montana has a statute with provisions very similar to those of Rule 44, FED. R. CIV. P. New Mexico's statute is substantially the same, with the exception that the first portion of the statute dealing with New Mexico records was rewritten.

⁹² MONT. REV. CODES ANN., Rule 44.

⁹³ Montana had previously adopted the Uniform Official Reports As Evidence Act and subsequently adopted a code of evidence which appears to be very similar to the Uniform Rules of Evidence.

3. Federal & Uniform Rules of Evidence

The Federal Rules of Evidence⁹⁴ or the Uniform Rules of Evidence⁹⁵ have been adopted in various forms by some states.⁹⁶ Rule 803(8) of the Uniform Rules is similar to Federal Rule 803(8) with several important differences, primarily in regard to investigative reports and factual findings by governmental agencies.⁹⁷ Specifically, investigative reports prepared by or for a government cannot be offered by it in a case in which it is a party. Factual findings offered by the government are specifically excluded by

⁹⁴ *Supra* note 77.

⁹⁵ *Supra* note 76.

⁹⁶ Among others, Minnesota, Arkansas, New Mexico, Florida, Maine, Montana, and California have adopted comprehensive evidence codes.

⁹⁷ UNIFORM RULE OF EVIDENCE 803 provides in pertinent part:

The following are not excluded by the hearsay rule, even though the declarant is available as a witness:

- (8) Public records and reports. (A) To the extent not otherwise provided in (B), records, reports, statements or data compilations in any form of a public office or agency setting forth its regularly conducted and regularly recorded activities, or matters observed pursuant to duty imposed by law and as to which there was a duty to report, or factual findings resulting from an investigation made pursuant to authority granted by law. (B) The following are not within this exception to the hearsay rule: (i) investigative reports by police or other law enforcement personnel; (ii) investigative reports prepared by or for a government, a public office or an agency when offered by it in a case in which it is a party; (iii) factual findings offered by the government in criminal cases; (iv) factual findings resulting from special investigation of a particular complaint, case, or incident; (v) any matter as to which the sources of information or other circumstances indicate a lack of trustworthiness.

Rule 803, FED. R. EV., provides in pertinent part as follows:

The following are not excluded by the hearsay rule, even though the declarant is available as a witness:

- (8) Records and reports. Records, reports, statements or data compilations, in any form, of public offices or agencies, setting forth (A) the activities of the office or agency, or (B) matters observed pursuant to duty imposed by law as to which matters there was a duty to report, excluding, however, in criminal cases matters observed by police officers and other law enforcement personnel, or (C) in civil actions and proceedings and against the government in criminal cases, factual findings resulting from an investigation made pursuant to authority granted by law, unless the sources of information or other circumstances indicate a lack of trustworthiness.

this rule and therefore are not an exception to the hearsay rule, while the Federal Rules seem to exclude such factual findings by implication. It is specifically provided in the Federal Rules of Evidence, however, that factual findings can be used against the government in criminal cases. Under the Uniform Rules, factual findings resulting from special investigations of a particular complaint, case, or incident are not permitted by Rule 803(8) and therefore are not an exception to the hearsay rule.

Therefore, it would appear that the Uniform Rules are indeed more restrictive than the Federal Rules regarding investigative reports. Under the Uniform Rules, while factual findings resulting from an investigation made pursuant to authority granted by law are not hearsay, factual findings from special investigations are hearsay and therefore inadmissible. The Uniform Rules are, however, less restrictive than the majority rule at common law regarding such reports. McCormick observes that the majority of courts exclude reports which are based partially on statements of others and which draw conclusions regarding causation or fault.⁹⁸ Nevertheless, McCormick advocates admissibility of such reports on the basis that official investigations are generally conducted by investigators who are specialists in the subject matter of the investigation and are usually on the scene to investigate at the earliest feasible time.⁹⁹

There seems to be little question that data compilations, records and reports of the National Weather Service should be admissible under Rule 803(8) of either the Federal or Uniform Rules regarding public records, subject always to proper authentication. Rules 902(4) of the Federal and Uniform Rules of Evidence are almost identical and provide for authenticating certified copies of public records by official seal. Thus, NWS data bearing the official seal of the Department of Commerce should meet the requirements of self-authenticating certification under both the Federal and Uniform Rules of Evidence.

⁹⁸ See C. McCORMICK, EVIDENCE, 616 (1954), and cases cited therein.

⁹⁹ McCormick, *Can the Courts Make Wider Use of Reports of Official Investigations?*, 42 IOWA L. REV. 363, 364 (1957).

4. *Specific Official Records Statutes*

a. *Texas Statute*

The Texas statute for official records, Article 3731a,¹⁰⁰ as originally enacted in 1951 and subsequently amended, provides that any written document made by an officer of Texas¹⁰¹ or the United States¹⁰² in the performance of the duties of his office shall be, so far as relevant, admitted into evidence for the matters contained in the document. However, such writing is admissible only if the party offering it has delivered a copy to the adverse party a reasonable time before trial unless in the opinion of the trial court the adverse party has not been unfairly surprised.¹⁰³ Such records or copies thereof must be accompanied by attestation of the officer having legal custody of the record or his deputy.¹⁰⁴ Except for records or documents from public offices of Texas, the attestation must be accompanied by a certificate that the attesting officer has custody of such writing.¹⁰⁵ This statute provides a single, simple method for proving up any official document and is basically the same as the Uniform Act discussed above. The analysis and cases cited with reference to that Act should apply equally with regard to the Texas statute.

b. *California Statutes*

In California, pursuant to Section 1280 of the California Evidence Code, official records of an act, condition, or event are an exception to the hearsay rule when the record was made by a public employee within the scope of his duty; was made at or near the time of the act, condition, or event; and the source of information and method and time of preparation were such as to indi-

¹⁰⁰ TEX. REV. CIV. STAT. ANN. art. 3731a, § 1 (Vernon Supp. 1978) provides: Any written statement, certificate, record, return or report made by an officer of this state or any governmental subdivision thereof, or a deputy or employee, in the performance of the functions of his office shall be, so far as relevant, admitted in the courts of this state as evidence of the matters stated therein, subject to the provisions of Section 3.

¹⁰¹ *Id.*

¹⁰² *Id.*, § 2.

¹⁰³ *Id.*, § 3.

¹⁰⁴ *Id.*, § 4.

¹⁰⁵ *Id.*

cate its trustworthiness.¹⁰⁶ The statute suggests that official records would be admissible even though they contain opinions or conclusions of the preparer, absent a showing that the method of preparation was not trustworthy.¹⁰⁷ The breadth of the statute would seem to indicate that NWS data should be admissible under this exception to the hearsay rule absent a showing that for some reason the data was not trustworthy.

Sections 1530 and 1531 of the Evidence Code provide for the use of a certified copy of an official document instead of the original. The copy may be authenticated by a certificate of the officer having custody of the writing to the effect that the certified copy is a correct copy of the original.¹⁰⁸ These statutes appear to have intentionally omitted the requirement that the document be under an official seal.¹⁰⁹ Therefore, it would appear that local certification by an NWS depository office may satisfy the California statute, and certainly certification under the seal of the Department of Commerce would satisfy all the statutory requirements for self-authenticating certification.

c. *New York Statutes*

New York has a series of statutes dealing with official records. However, only two of those statutes will be considered herein.

Rule 4540 of the Civil Practice Law and Rules provides that an official publication or copy attested as correct by an officer or a deputy having legal custody of an official record of the United States or any state or any of its offices, public bodies or boards, is prima facie evidence of such record.¹¹⁰ Where the record is from

¹⁰⁶ CAL. EVID. CODE § 1280 (West 1963) provides:

Evidence of a writing made as a record of an act, condition, or event is not made inadmissible by the hearsay rule when offered to prove the act, condition or event if:

(a) the writing was made by and within the scope of duty of a public employee;

(b) the writing was made at or near the time of the act, condition or event; and

(c) the sources of information and method and time of preparation were such as to indicate its trustworthiness.

¹⁰⁷ Dutton, *The Official Records Exception To The Hearsay Rule in California*, 6 SANTA CLARA LAWYER 1 (1965).

¹⁰⁸ CAL. EVID. CODE §§ 1530, 1531 (West 1963).

¹⁰⁹ See the official comments to CAL. EVID. CODE § 1530 (West 1963).

¹¹⁰ N.Y. CIV. PRAC. R. 4520 (McKinney 1963).

another state, it must be under the seal of the office from which it came.¹¹¹ Other provisions are made for officers having no seal of office, but no such provision is made for any department of the United States government. It may be that a local certification by an agency of the United States would be sufficient.

Rule 4528 specifically provides that any record of the observations of weather, taken under the direction of the United States Weather Bureau, is *prima facie* evidence of the facts stated therein. It has been held that national weather bureau records are admissible as evidence of the conditions existing at the time of a plaintiff's injury.¹¹²

From the foregoing it would appear that weather data is admissible as an exception to the hearsay rule, and that authentication can be accomplished by obtaining certified copies under the official seal of the Department of Commerce. Although the point is unclear, it may be that local certification to the effect that the certified copy is an accurate copy of the original would be sufficient, since local weather bureaus do not have an official seal of office nor are they permitted to issue official Department of Commerce certification.

C. Strength of Weather Data as Evidence

The general rule is recognized that public records prepared and kept by public officials as required by their offices are admissible, subject to the bounds of relevance, as proof of facts stated therein as an exception to the hearsay rule.¹¹³ Such data is usually regarded as stronger proof than oral testimony but not conclusive of facts stated therein.¹¹⁴ It appears that the most prevalent view is that weather records are *prima facie* evidence of the weather conditions existing at a particular place and time.¹¹⁵ Weather reports and records are accorded greater weight than the testimony of witnesses relying upon their memory.¹¹⁶

Many states and the federal courts have recognized the rule that

¹¹¹ N.Y. CIV. PRAC. R. 4540(c) (McKinney 1963).

¹¹² *Schleede v. State*, 5 Misc.2d 785, 160 N.Y.S.2d 686 (Ct. Cl. 1957); *Bretsch v. Plate*, 82 App. Div. 399, 81 N.Y.S. 868 (1903).

¹¹³ Annot., 57 A.L.R.3d 713, 716 (1974).

¹¹⁴ 30 AM. JUR. 2d *Evidence* § 1108 (1967).

¹¹⁵ Annot., *supra* note 113, at 717.

¹¹⁶ *Id.*

authenticated weather records, kept by official weather agencies, are admissible on the issue of weather conditions at a particular time and place.¹¹⁷ Some courts have held that observations made at a remote place or time are inadmissible.¹¹⁸ Texas courts, however, have permitted introduction of weather data over objection as to remoteness, even where observations were made sixty miles from the scene of alleged crop damage by aerial spraying, when accompanied by testimony concerning the actual conditions at the location in question.¹¹⁹ It would appear that generally the weight to be accorded weather documents varies proportionately to the distance between the place of the controversy and the place where the weather observations were made.¹²⁰

VI. CONCLUSION

Even with recent improvements in aircraft and equipment capabilities, weather conditions continue to play a substantial role in general aviation operations. Although equipment sophistication continues to improve light aircraft capabilities, it has far from removed the limitations imposed by weather. Turbulence, snow, hail, structural icing, power plant icing, thunderstorms, smoke, haze, and fog continue to inhibit aircraft operations, and contribute to aircraft accidents, almost as much today as in the past.

While the national weather system is a very complex network of observation and forecasting offices, the practicing attorney can avoid the time, trouble, and expense of weather data procurement by familiarizing himself with the basic weather products most useful to his inquiry and by directing his requests for data to the appropriate agency. It may be necessary at times to move swiftly to preserve products with relatively short destruction times. However, the procedures for preserving and obtaining weather data in weather related aircraft accidents should become an almost routine part of case investigation and preparation.

¹¹⁷ See *Pitchfork Land & Cattle Co. v. King*, 335 S.W.2d 624 (Tex. Civ. App.—Amarillo 1960), *rev'd on other grounds*, 346 S.W.2d 598 (Tex. 1961); *Aerial Sprayers, Inc. v. King*, 317 S.W.2d 602 (Tex. Civ. App.—Amarillo 1958, no writ); *Hillin v. Hagler*, 286 S.W.2d 661 (Tex. Civ. App.—Ft. Worth 1956, no writ); *Taylor v. State*, 158 S.W.2d 881 (Tex. Civ. App.—Waco 1942, writ *ref'd w.o.m.*); see also Annot., 57 A.L.R.3d at 719-21.

¹¹⁸ See Annot., 57 A.L.R.3d at 729-30.

¹¹⁹ See *Pitchfork Land & Cattle Co. v. King*; *Aerial Sprayers, Inc. v. King*.

¹²⁰ See Annot., 57 A.L.R.3d at 717.

Current Literature

